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# Hazard Analysis

## Respirator Canister Challenges



Draft for Discussion



# Sorbant / Media Based Classification of Challenge Agents

- Classification into **Agent Families**
- **Test Representative Agent (TRA)** required for each family of agents.
- **Back up data** with other agents within family are being generated.
- **Biological and Radiological** agents are addressed as particulates requiring mechanical P-100 media

## **Families / Test Representative Agents (TRA)**

- **Acid Gas / TRA** =  $\text{SO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{CNCL}$ ,  $\text{COCl}_2$ ,  $\text{HCN}$
- **Base Gas / TRA** = Ammonia
- **Hydrocarbon / TRA** = Carbon Tetrachloride or Cyclohexane
- **Hydrides / TRA** = Phosphine
- **Isocyanate / TRA** = ??
- **Carbon Monoxide / TRA** = Carbon Monoxide
- **Nitrogen Oxide / TRA** =  $\text{NO}_2$
- **Particulate / TRA** = DOP
- **Formaldehyde / TRA** = Formaldehyde
- **Unknown / further study required**
- **Air Supplied** - Air Supplied respirators required

# First Step: Hazards Concept

- Need to develop a standard immediately
- Addressing the initial vulnerability assessment list of chemical agent hazards (151) to develop data to confirm the Agent Families and Test Representative Agent.(TRA) will time consuming
- Chemical Agent Hazard List has not been finalized by the NIOSH Toxicologists, list could grow to >200 chemicals

# Test Representative Agents

- **Ammonia** - NIOSH (42 CFR Part 84) & EN (141)
- **Carbon Monoxide** - NIOSH
- **Carbon Tetrachloride** - Organic Vapor - NIOSH
- **Cyanogen Chloride** - Military (EA-DTL-1704A)
- **Cyclohexane** - Organic Vapor - EN
- **Formaldehyde** - NIOSH
- **Hydrogen Cyanide** - NIOSH, EN & Military
- **Hydrogen Sulfide** - NIOSH & EN
- **Nitrogen Dioxide** - NIOSH & EN
- **Phosgene** - Military
- **Phosphine** - NIOSH
- **Sulfur Dioxide** - NIOSH & EN
- **DOP** - NIOSH (P-100 Particulate Test)



# First Step Hazard Concept: Protection Summary

- Testing of the TRA should provide protection for the following Chemical agents **(108)** on the NIOSH CWA /TIC Threat List (151), plus Particulate Biological agents **(13)** & Particulate Radiological/Nuclear agents **(16)**:
  - 61 Organic Vapor Family**, with vapor pressures less than those of Carbon Tetrachloride and Cyclohexane (TRA). By using this logic would including GB and HD.
  - 27 Acid Gas Family**, TRA's = Cyanogen Chloride, Phosgene, Hydrogen Cyanide, Hydrogen Sulfide, and Sulfur Dioxide.
  - 3 Base Gas Family**, TRA = Ammonia.
  - 4 Hydride Family**, TRA = Phosphine.
  - 6 Nitrogen Oxide Family**, TRA = Nitrogen Dioxide.
  - 1 Formaldehyde Family**, only member of family and is TRC.
  - 3 Carbon Monoxide Family**, TRA = Carbon Monoxide
  - 32 Particulate Family**, TRA = DOP



Organic Vapor Family		Acid Gas Family
acetone cyanohydrin	mustard, lewisite mixture	boron tribromide
acrylonitrile	nitrogen mustard HN-1	boron trichloride
allyl alcohol	nitrogen mustard HN-2	boron trifluoride
allyl chlorocarbonate	nitrogen mustard HN-3	bromine
bromoacetone	n-propyl chloroformate	bromine chloride
bromobenzylcyanide	o-chlorobenzylidene malononitrile	bromine trifluoride
chloroacetone	parathion	carbonyl fluoride
chloroacetonitrile	perchloromethyl mercaptan	chlorine
chloroacetophenone	phenyl mercaptan	chlorine pentafluoride
chloroacetophenone / chloroform / chloropicrin (23/38.4/38.4)	phenylcarbylamine chloride	chlorine trifluoride
chloroacetyl chloride	phenyldichloroarsine	chlorosulfonic acid
chloropicrin	phosgene	cyanogen chloride
chloropivaloyl chloride	oximedichloroformoxime	
crotonaldehyde	sarin	dichlorosilane
cyclohexyl methyphosphonate	sec-butyl chloroformate	ethyl phosphonous dichloride
dibenz-(b,f)-1,4-oxazepine	soman	fluorine
diketene	tabun	hydrogen bromide
dimethyl sulfate	tert-octyl mercaptan	hydrogen chloride
diphenylchloroarsine	tetraethyl dithiopyrophosphate	hydrogen cyanide
diphenylcyanoarsine	tetraethyl lead	hydrogen fluoride
distilled mustard	tetramethyl lead	hydrogen iodide
ethyl chloroformate	tetranitromethane	hydrogen sulfide
ethyl chlorothioformate	trimethoxysilane	phosgene
ethyl phosphorodichloridate	trimethylacetyl chloride	phosphorus trichloride
	V-Sub X	silicon tetrafluoride

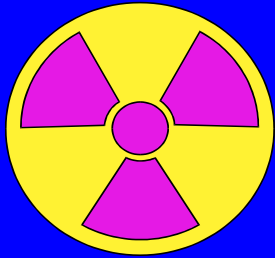
Base Gas Family	Nitrogen Oxide Family	Hydride Family	Formaldehyde Family	Carbon Monoxide Family	Particulate Family
allyl amine	nitric acid	arsine	formaldehyde	carbon monoxide	adamsite
ammonia	nitric acid, fuming	germane		iron pentacarbonyl*	sodium azide
dimethyl hydrazine, 1,2	nitric oxide	phosphine		nickel carbonyl*	sodium fluoroacetate
methyl hydrazine	nitrogen dioxide	stibine			+
	nitrogen tetraoxide				(13) Biologicals Agents
	nitrogen trioxide				(16) Radiological / Nuclear agents



# Particulate Biological Agents

(USAMRIID and/or CDC Lists)

- **Anthrax**
- **Brucellosis**
- **Glanders**
- **Pneumonic Plague**
- **Tularemia**
- **Q Fever**
- **Smallpox**
- **Venezuelan Equine Encephalitis**
- **Viral Hemorrhagic Fevers**
- **T-2 Mycotoxins**
- **Botulism**
- **Ricin**
- **Staphylococcus Enterotoxin B**

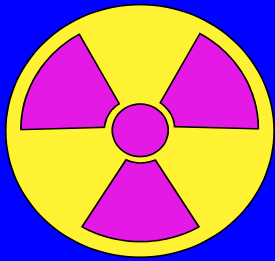


# Particulate Radiological\Nuclear Agents

(USAMRIID and/or DOE Lists)

- Hydrogen 3
- Carbon 14
- Phosphorous 32
- Cobalt 60
- Nickel 63
- Strontium 90
- Technetium 99m
- Iodine 131
- Cesium 137
- Promethium 147
- Thallium 204
- Radium 226
- Thorium 232
- Uranium 235 & 238
- Plutonium 239
- Americium 241





# Respiratory Protection

**The Department of Energy recommends full-face respiratory protection for entrance into a radiologically contaminated area. *DOE/RW-0362 SR Office of Civilian Radiological Waste Management***

**The respiratory threat can be eliminated by employing High Efficiency Particulate Air (HEPA) or P100 filters. *Domestic Preparedness Technician-HAZMAT Course***

**The U.S. Army specifies a M40 full-face gas mask with a two-element canister containing (HEPA) filtration and ASZM-T Cooperite carbon filtration media.**



# Systems Based Permeation & Penetration Challenges

- Respirator systems, unlike canisters, will be challenged with chemical warfare agents.
- Challenges are based on the Most Creditable Event indoor scenarios
- Sarin (**GB**) vapor challenge =  $2000 \text{ mg/m}^3$
- Distilled Sulfur Mustard (**HD**) vapor challenge =  $300 \text{ mg/m}^3$ , liquid droplet challenge approximately  $10 \text{ g/m}^3$
- Test protocols will be consistent with use scenarios



## System Test - Sarin (GB)

Ct = 10,000

